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(54) Title: SYSTEMS AND METHODS FOR MICROARRAY DATA ANALYSIS

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EM_ESTIMATE ( $\mu_1, \dots, \mu_K, \Sigma_1, \dots, \Sigma_K, \tau_1, \dots, \tau_K, A'$ )
{
  FOR EACH ROW R OF A' WITH MISSING VALUES
  {
    FOR  $j = 1, \dots, K$ 
    {
      USE EM AND  $N(\mu_j, \Sigma_j)$  TO ESTIMATE THE
      MISSING VALUES IN R.
    }
     $R_i \leftarrow R$  WITH MISSING VALUES REPLACED BY ESTIMATES.
  }
   $R' \leftarrow \text{WEIGHTED AVERAGE}(R_1, \dots, R_K)$ .
  REPLACE R IN A' BY R'.
  RETURN A'.
}
```

```
K_ESTIMATE(K, A)
{
  /* FIRST PART: INITIALIZATION */
  B  $\leftarrow$  ROWS OF A WITHOUT MISSING VALUES.
   $\mu_1, \dots, \mu_K, \Sigma_1, \dots, \Sigma_K, \tau_1, \dots, \tau_K \leftarrow$ 
  GAUSSIAN MIXTURE CLUSTERING OF B.
  A'  $\leftarrow$  EM_ESTIMATE ( $\mu_1, \dots, \mu_K, \Sigma_1, \dots, \Sigma_K, \tau_1, \dots, \tau_K, A$ ).
  /* SECOND PART: ITERATION */
  REPEAT
  {
     $\mu_1, \dots, \mu_K, \Sigma_1, \dots, \Sigma_K, \tau_1, \dots, \tau_K \leftarrow$ 
    GAUSSIAN MIXTURE CLUSTERING OF A'.
    A'  $\leftarrow$  EM_ESTIMATE ( $\mu_1, \dots, \mu_K, \Sigma_1, \dots, \Sigma_K, \tau_1, \dots, \tau_K, A'$ ).
  } UNTIL CONVERGENCE
}
```

```
GMCimpute(S, A)
{
  FOR  $K = 1, 2, \dots, S$ 
  {
     $A_K \leftarrow$  K_ESTIMATE(K, A).
  }
  RETURN  $(A_1 + A_2 + \dots + A_S) / S$ .
}
```

(57) Abstract: Clustering is routinely applied in the exploratory analysis of microarray data. Missing entries arise from blemishes on the microarrays. The present invention provides a new method, and computer program and/or computer product thereof to impute missing values. The method involves the steps of clustering microarray data by partitioning the data into a select number of clusters, wherein each data point is iteratively moved from one cluster to another, until two consecutive iterations have resulted in the same partition pattern; obtaining a select number of estimates of the data in the clusters by probabilistic interference; and averaging the select number of estimates to obtain missing values in the microarray data. The method is superior to other imputation models as measured by root mean squared errors.

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